Conjecture on imminent earthquake prediction — from shaving foam to cloud patterns

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Abstract

A conjecture on imminent earthquake prediction is presented. Drastic geological deformations of crustal rock strata taking place immediately (hours/days) before an earthquake may cause fast air or gas emission/absorption vertically in between ground and sky. I conjecture, inspired by an observation of strange patterns appearing on shaving foam, that this fast movement of air fluid may produce unusual cloud patterns at interfaces between atmosphere levels. This air movement is vertical and drastic, different from the horizontal and moderate meteorological air movement, hence its caused cloud patterns are expected to be different from meteorological cloud patterns. This provides a possible origin for the so-called *earthquake cloud*. Recognition of different earthquake cloud patterns may provide a practical way to estimate location, magnitude and strength of geological deformations of rock strata, and hence a method with support of physics for imminent earthquake prediction. In the end of this paper an experiment has been designed to test the conjecture.

§ 1. Introduction

Imminent earthquake prediction is a difficult problem. Only long-term (years to decades) and medium-term (months to years) predictions are regarded possible at present, while imminent/short term predictions are commonly thought to be negative [*]. See *Wikipedia: earthquake prediction*, and Refs.[1, 2, 3, 4, 5, 6]. The conjecture and research proposal of this paper are a suggestion and attempt only.

This paper is arranged as follows. The conjecture will be outlined in §2, of which the central idea is *vertical fast air emission/absorption causing cloud patterns*. This idea is inspired by an observation of strange patterns on shaving foam of §3. Discussions on geological deformations of crustal rock strata and the induced vertical fast air movement will be presented in §4. This air movement may lead to formation of *earthquake cloud* patterns, hence a literature survey for earthquake cloud, including some sorts of explanations, is presented in §5. Potential evidences for the conjecture, as well as the induced side-effects, will be listed in §6. An experiment designed to test the conjecture will be given in §7. Finally, the paper will be summarized in §8, followed by some remarks in §9.

[*]Approaches seismologists have used to investigate earthquakes include the researches on seismicity patterns, crustal movements, ground water level in wells, radon or hydrogen gas emissions, changes of seismic wave velocities, electromagnetic fields (seismo-electromagnetics), large-scale changes in soil temperature, changes in ion concentration in the ionosphere, and so on.

§ 2. Conjecture and research proposal

A conjecture is made on imminent/short term earthquake prediction based on cloud patterns caused by fast air emission/absorption between ground and sky:

1. Immense volume of air (or gas) stuffs gaps and cracks among crustal rock strata. Geological deformations could either squeeze this air out, or produce more room in the rock strata gaps to absorb in the air from outside.
2. It is a reasonable hypothesis that earthquakes (or, a part of earthquakes) are three-stage events, from energy preparation to release [7]:
   (a) Long-term preparation (years prior to an earthquake): Gradual geologic motions of tectonic plates push rock strata to undergo geologic deformations, such as bending, compression, etc.. Seismological energy is accumulated in this stage. Geologic deformations become more and more severe when close to the earthquake, accompanied by occurrence of more and more minor breakings.
   (b) **Eve of event** (hours to days prior to the earthquake): This short stage is the final preparation period. Occurrence of one or two medium-size breakings make the rock strata suffer *a series of drastic geologic deformations* within a short time, which will trigger the eventual major breaking and collapses.
   (c) Occurrence of event (disastrous moment): Major breaking and collapses take place, seismological energy being released.
3. The eve of event stage is crucial for imminent earthquake prediction. I conjecture that those *drastic deformations of rock strata* will cause a huge pressure difference of air between the two sides of the Earth soil surface, because the thick soil surface covers the rock strata and acts as an obstruction of air release (see Fig.5 below). Consequently, vertical high-speed air emission and absorption can be produced between the ground and sky. In regard to the observation of the following §3, I conjecture that this air movement will lead to formation of unusual cloud patterns on interfaces between atmosphere levels. This provides a possible origin for the folk-called *earthquake cloud*.
4. This air emission/absorption is vertical and drastic, different from the horizontal and moderate meteorological movements of atmosphere, hence its induced cloud patterns are expected to be different from meteorological cloud patterns[*]. Therefore, earthquake cloud appearing hours/days before an earthquake could be a candidate for imminent/short term earthquake prediction, with support of physics.
5. Furthermore, it is thought that different magnitude, strength and velocity of air emission/absorption could produce different cloud patterns. Hence the patterns provide a way to reveal more quantitative information of location, magnitude and strength of the geologic deformation of rock strata, and hence of the impending earthquake.

The conjecture leads to the following **research proposal**, which is a study of inverse problem:

▷ *Step 1 (Cloud patterns):* Distinguishing the cloud patterns of earthquakes from the cloud

[*]Vertical air movements may also appear in extreme weather situations. However, since earthquakes and extreme weather are both small-probability events, the probability of co-existence of them is even smaller.

patterns of meteorological movements of atmosphere, and further recognizing different sorts of patterns of earthquake cloud.

- ▷ *Step 2 (Air movement):* Estimating magnitude, strength and velocity of vertical air emission and absorption — establishing workable mathematical/mechanical models.
- ▷ *Step 3 (Geologic deformations):* Estimating locations, magnitude and strength of geologic deformations of rock strata, with the aid of long- and medium-term predictions of seismology.
- ▷ *Step 4 (Final purpose):* Imminently predicting earthquakes.

§ 3. Patterns appearing on shaving foam

The idea of *air-emission causing patterns* is inspired by the following observation on strange patterns appearing on shaving foam when the foam is sprayed out from an aerosol can. See Fig.1.

Before that observation I took for granted that the sprayed foam should always be smooth, as in Fig.2; however, it was not the case. Instead, in some situations, such as "*half-filled can plus shaking the can 4 or 5 times*", patterns appeared on the sprayed foam. See Figs.1 and 3.

Fig. 1: Shaving foam sprayed out from an aerosol can. *Left*: The sample used was a half-filled can of *Gillette Lemon Lime*, which was shaken 4 or 5 times before spraying. *Right*: The foam was sprayed out from the can and patterns appeared on the foam surface.

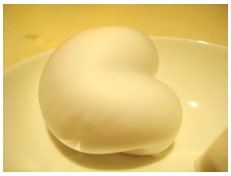


Fig. 2: Smooth foam containing no patterns.

In Figs.1 and 3 different patterns are shown, including the eye-like and the rose-like. I attribute the formation of these patterns to the fast aerosol spray. This spray was caused by the pressure difference between the inside and outside of the aerosol can, while the pattern formation was governed by some fluid dynamical mechanism that is still unknown [*]. See Fig.4 below.

[*]For instance, a possible mechanism is that the fast spray causes oscillation and waves in the aerosol which form the patterns at the interface between the aerosol and the outer air, just like sound waves in air which are able to cause ripples when travelling over smooth water surface.

Eye-like patterns

Rose-like patterns

Fig. 3: More patterns on shaving foam.

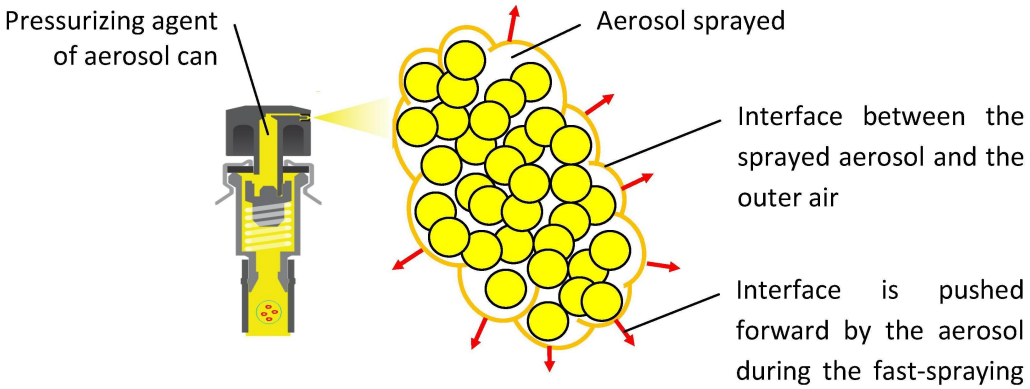
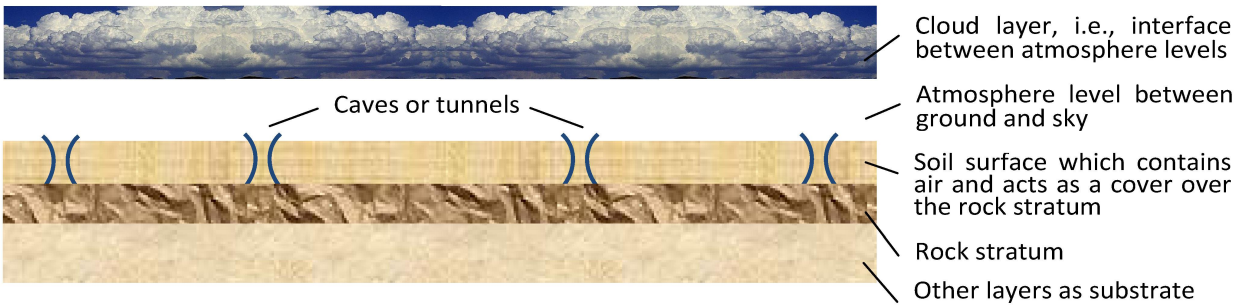


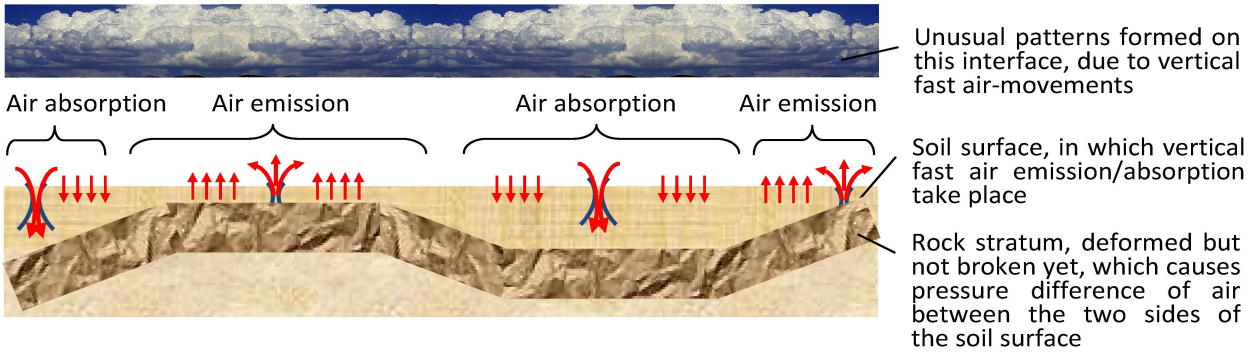
Fig. 4: Aerosol is fast sprayed out from a can. During the spray process, the interface between the aerosol and the outer air is strongly pushed forward by the aerosol, where some unknown fluid dynamical mechanism causes appearance of strange patterns on the interface.

§ 4. Fast air emission/absorption due to geological deformations

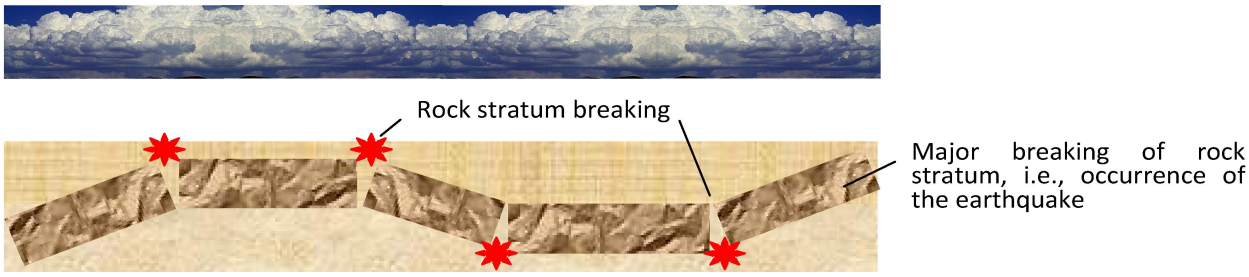
The phenomena observed above could occur on cloud prior to an earthquake (see Fig.5 below). As mentioned in §2, many an earthquake has a crucial short stage immediately before the major breaking moment, where drastic geological deformations take place. The thick soil surface covering the rock strata causes a huge pressure difference of air between the two sides of the soil surface, which leads to vertical fast air emission and absorption. The bigger the deformations are, the more violent the air emission and absorption are.



Long-term preparation stage: Seismological energy accumulation, during geological deformations.



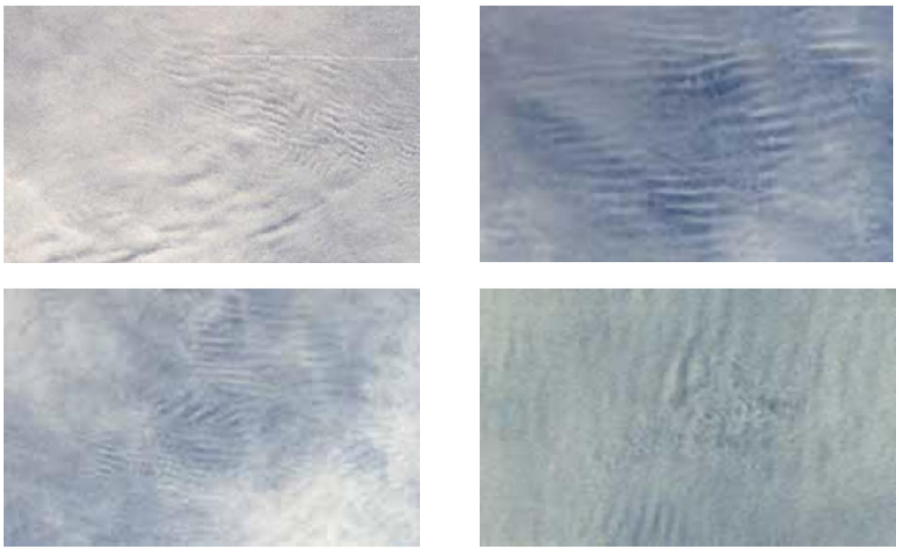
Eve stage of earthquake event: The rock stratum experiences drastic deformations prior to the earthquake. Due to the deformations, as well as the covering of the Earth soil surface, huge pressure difference of air is formed between the two sides of the soil surface, leading to fast air emission and absorption. This air movement may cause unusual cloud patterns on the interfaces between atmosphere levels, which provides a possible explanation for the folk-called “earthquake cloud”.



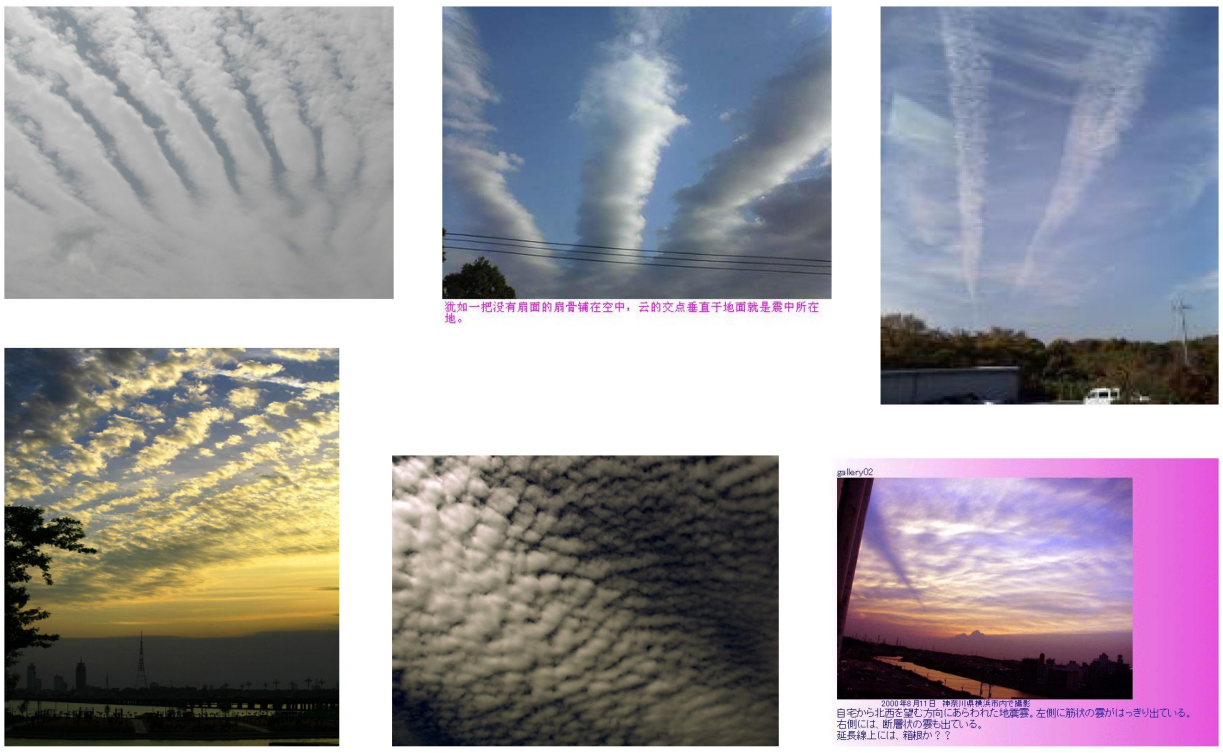
Occurrence stage of earthquake event: Major breaking happens to the rock stratum, seismological energy being released.

Fig. 5: Three stages of earthquake event. The second stage, *eve of event*, is crucial for imminent earthquake prediction, where vertical fast air emission and absorption could form unusual cloud patterns on interfaces between atmosphere levels.

§ 5. Literature survey of earthquake cloud



Satellite view: Unusual patterns appearing in meteorological images prior to occurrence of earthquakes



Ground view: Unusual patterns appearing in cloud prior to occurrence of earthquakes.
[The text below the middle photo in the top row: "*(the cloud is) like a folding fan spanned in sky, with the centre of the circular sector indicating the epicentre*".]

Fig. 6: Photos of the so-called earthquake clouds from different angles of view. (Meteorological satellite images are from Ref.[8].)

Earthquake cloud has not been commonly accepted by the scientific community as a sign of impending earthquakes [9]. There are diametrically opposite opinions: some people treat simultaneous occurrence of unusual-looking cloud and an earthquake as a coincidence; but some people believe the strange-looking clouds in Fig.6 are associated with seismic events.

Earthquake cloud has been observed and studied for years, based on which some earthquake predictions have been made. For instance, a Chinese folk-scientist named Z. Shou claimed that he had made dozens of earthquake predictions based on cloud patterns in satellite images, with a 68% accuracy [10, 11]. He identified five types of earthquake cloud — line-shaped, feather-shaped, lantern-shaped clouds, etc. — and claimed that appearance of any one of these clouds indicates an impending earthquake to occur within several hours to 103 days (averagely 30 days).

Some explanations for earthquake cloud are the following [9]:

▷ *Heat-flow paradox*

Claim: Deformations and motions of rock strata cause rock frictions, and hence produce a vast amount of thermal energy. This energy heats water to 1500°C such that hot vapor obtains an updraft to form earthquake cloud. This explanation is held by Z. Shou.

Deficiency: If this is true, such hot vapor should have been noticed by human beings, but that is not the case. In addition, geophysicists have conducted experiments and pointed out that this heating is only 4°C or so, not enough to produce earthquake cloud [8].

▷ *Effect of piezoelectricity*

Claim: Piezoelectricity occurring inside the Earth causes local variation of geomagnetic field, which leads to variation in electromagnetic fields in sky and thus forms earthquake cloud.

Deficiency: This explanation is unconvincing. Piezoelectricity is a kind of electromagnetic effect, which is far too weak to affect motions of atmosphere. Moreover, if the piezoelectricity is strong enough to drive motions of air, then horrible electromagnetic noise must have been created to disrupt communications and destruct electronic devices. But that is not the case apparently.

From my point of view, only the explanations mostly based on mechanical reasons are acceptable. My explanation is the following, associated with the conjecture of §2:

> An earthquake event has a final preparation stage immediately before the major breaking moment, where the drastic geological deformations cause vertical fast air movements which produce earthquake cloud. Some unknown mechanism of fluid dynamics takes effect in this process, similar to that of the footnote on Page 3. I.e., fast air movements produce oscillation and (sound) waves in the atmosphere when the waves propagate to the interfaces between atmosphere levels. The sound waves produced by the air movement could be ultra-, acoustic or infrasound.

§ 6. Potential evidences and side effects

Vertical fast air emission/absorption via the Earth soil surface, either by rushing through caves and tunnels or by penetrating through soil (as shown in Fig.5), could have potential evidences and induced side effects:

▷ *Gas emission prior to volcanic eruption*

It is instructive to refer to the phenomenon of gas emission before volcanic eruption, which is an example of vertical fast air emission associated with geological motions of rock strata of tectonic plates.

▷ *Sound effect*

Air emitted through caves, tunnels or soil may produce sound waves of high, intermediate or low frequency, as a horn does when air passing through it. Hence ultra-, acoustic or infrasound could be heard by human ears or devices before earthquake events. *

▷ *Light effect*

High-speed air movement may cause frictions among ionized air masses which result in the phenomenon of lightening. This could be an origin for the so-called *earthquake light*.

▷ *Atmospheric ionization*

According to Wadatsumi (Okayama University of Science, Japan) [12], ionization of atmospheric aerosol rises remarkably prior to an earthquake, which results in a phenomenon that the color of sky turns red. Human beings may feel uncomfortable and depressed in such a gas emitted from the inside Earth.

▷ *Release of radon gas*

Radon (Rn, atomic number 86) is a radioactive, colorless, odorless, tasteless noble gas, which is thought to be released from fault zones prior to earth slipping. Researchers have investigated changes in groundwater radon concentrations for earthquake prediction.

See the work of the research group led by G. Charpak (Nobel laureate in physics, 1992) in [13].

▷ *Anomalous animal behaviors*

Animals, especially those burrowing and underground-living animals, will probably be disturbed by the bad smell or even toxic gas emitted from the inside Earth.

*This sound effect might be different from the so-called phenomenon of *earthquake sound* which takes place seconds or minutes ahead of earthquake occurrence.

§ 7. Design of experiment to test vertical fast air movement

An experiment is designed to test the conjecture of §2 and §4:

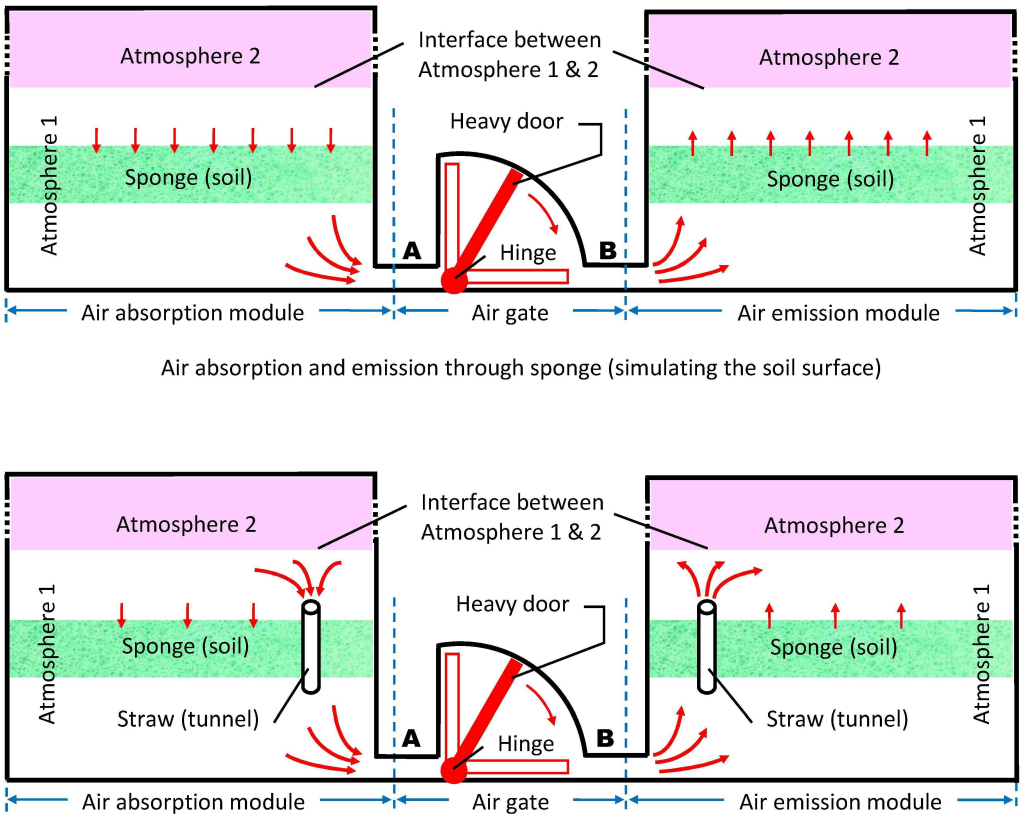


Fig. 7: Experiment designed to observe patterns on atmosphere interfaces formed by air emission/absorption. In this experiment sponge is used to simulate the Earth soil surface, and straws to simulate caves and tunnels.

▷ *Upper part of Fig.7 — air penetrating through soil*

This set-up is divided into three modules:

- *Middle — Air-gate module*: It is an empty quarter-cylinder, which has two entries marked as Gate **A** and **B**. This module contains an air marked as Atmosphere 1. A standing heavy door is placed in this module, which can fall down by rotating about a hinge. This door serves as an air piston.
- *Left — Air absorption module*: It is connected to the Air-gate via Gate **A**. This module contains not only Atmosphere 1, but also another air marked as Atmosphere 2 located on top of Atmosphere 1. Atmosphere 2 is lighter in density. These two Atmospheres should be carefully chosen, such that they do not mix up with each other and have a clear interface on which the desired patterns can be demonstrated. In the middle of this module a layer of sponge is placed to play the role of the Earth soil surface.
- *Right — Air emission module*: It is connected to the Air-gate via Gate **B**. This module also contains Atmosphere 1 and 2, with the latter on top of the former, to form a clear interface. In the middle of this module there is also a sponge.

In the Middle module, when the piston door falls down, air is fast absorbed in from the Left module via Gate A. At the same time, in the Left module, the part of Atmosphere 1 above the sponge is absorbed down to penetrate through the sponge. During this process, *patterns are expected to appear on the interface between Atmospheres 1 and 2 in the Left module.*

Similarly, when the piston door of the Middle module falls down, air is fast pumped out from the Middle to the Right module via Gate B. At the same time, in the Right module, the part of Atmosphere 1 beneath the sponge is emitted up to penetrate through the sponge, and *patterns are expected to appear on the interface between Atmospheres 1 and 2 in the Right module.*

The purpose of this experiment is to observe the patterns formed on the interfaces, with the presence of the obstructive sponge which simulates the Earth soil surface.

▷ *Lower part of Fig.7 — air spraying through caves and tunnels or penetrating through soil*

This set-up is almost the same as the upper part. The only difference lies in that several straws are placed in the sponge, for the purpose of simulating caves and tunnels of the soil surface. They provide another air passageway in addition to the sponge, such that air can either rush through the straws or penetrate through the sponge. It is expected that different patterns could be obtained on the interfaces between Atmospheres 1 and 2 in the Left and Right modules.

In this experiment we can choose different-sized Air-gate modules, to produce air movement with different magnitude, strength and velocity. We expect to obtain different patterns on the interfaces. Moreover, different choices of Atmospheres 1 and 2 are expected to bring extra alteration to the patterns obtained.

§ 8. Summary

In this paper a conjecture is made on imminent earthquake prediction based on cloud patterns. In §2 the contents of the conjecture are outlined. In §3 an observation of the strange patterns appearing on shaving foam are presented. In §4 it is illustrated that drastic geological deformations of rock strata, taking place immediately (hours/days) before an earthquake, may cause fast air emission/absorption through the Earth soil surface, vertically in between ground and sky. Inspired by the observation of §3, it is conjectured that this fast movement of air fluid may produce unusual cloud patterns at interfaces between atmosphere levels. Different from the horizontal and moderate meteorological air movement, this air movement is vertical and drastic, hence its caused cloud patterns are expected to be different from meteorological cloud patterns. This provides a possible origin for the so-called *earthquake cloud*. Recognition of different earthquake patterns could provide a practical way to estimate magnitude, strength and location of geological deformations of rock strata, and hence a physical method for imminent earthquake prediction. In §5 literature survey and explanations for earthquake cloud are presented. In §6 potential evidences of the vertical fast air emission/absorption and some induced side effects are listed. Finally in §7 an experiment is designed to test the conjecture.

§ 9. Remarks

▷ In §3 an observation of the strange patterns on shaving foam has been shown. The sample used was *Gillette Lemon Lime*, and the experimental condition is "*half-filled can plus 4–5 shakes*". Another sample, *Gillette Sensitive Skin* foam, has been tried as well, for which it is found that the condition of producing patterns is different, and the patterns obtained are not so clear. This implies that the ingredients of aerosol may somehow affect the patterns formed.

▷ The personal research areas of the author are *topological fluid mechanics* and *topological quantum field theory*, far from the topic of this paper. This paper stems from my personal interest; it is an attempt to share ideas with colleagues. There is not much mathematics in this paper, and the ideas could be incorrect.

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